A Study of Critical Technology Events in the Development of Selected Army Weapons Systems

Army Science Conference

30 November 2006

Richard Chait and John Lyons

Center for Technology and National Security Policy

National Defense University

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
01 NOV 2006	**N/A**	**-**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
A Study of Critical Technology Events in the Development of Selected Army Weapons Systems	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Center for Technology and National Security Policy National Defense University**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

13. SUPPLEMENTARY NOTES
See also ADM002075., The original document contains color images.

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**UU**	**22**	

Acknowledgments

- Tom Killion
- Hans Binnendijk
- Duncan Long
- Al Sciarretta
- Interviewees

Selected Army Systems

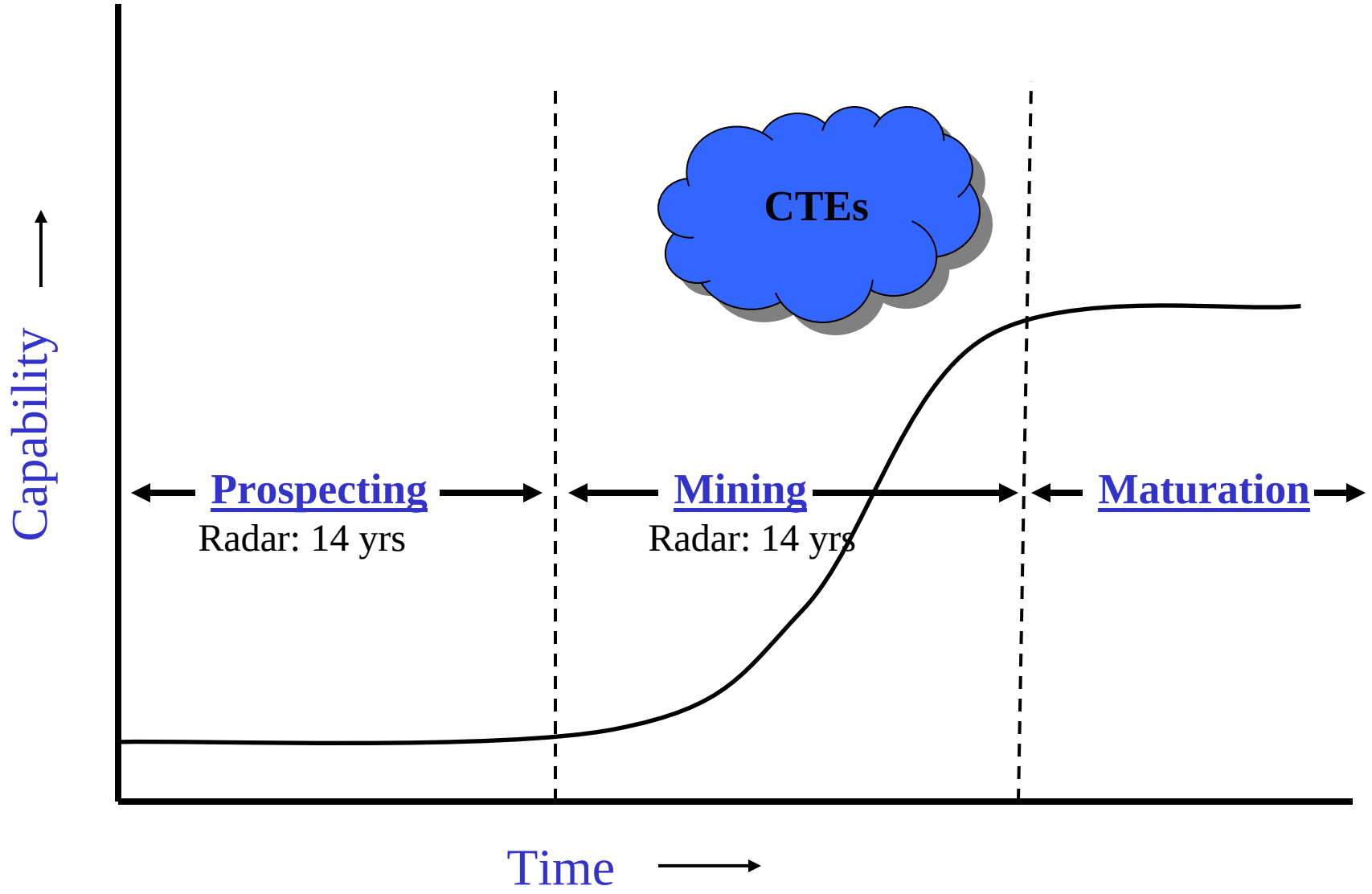
Objectives

- Study history of successfully fielded Army systems
- Gain insight into important factors underpinning system technology development by assessing
  - In-house, industry, and academic involvement
  - PM role
  - Funding source
  - Leveraging efforts
- Provide findings and recommendations to Army leadership to meet today's and tomorrow's S&T program management challenges

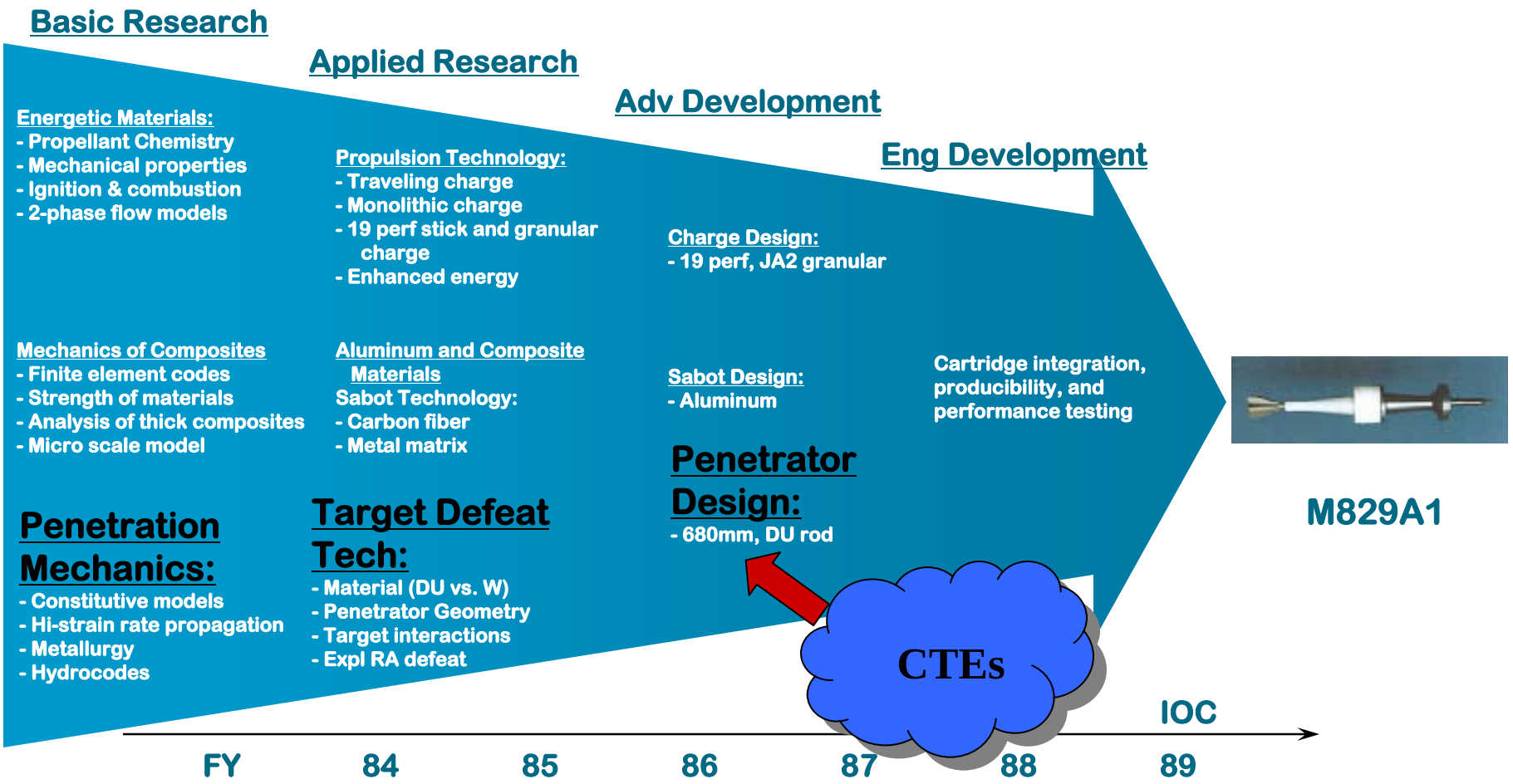
Approach

- Locate and interview key managers, S&Es and technicians (total ~140)
- Request key information in form of Critical Technology Events (CTEs). CTEs:
  - Are central technology events in the development of a weapons system that has led to a key capability
  - Include analyses, concepts, models, patents and processes
  - Can also include capability decisions made by management
  - Can originate in industry, in-house government labs, academia, or with international partners

Innovation Timeline



Evolution of the KE Projectile – Importance of Basic & Applied Research



Basic research still vital

CTE Count by Subsystem

Abrams (55)	Apache (44)	Stinger/Javelin (35)
Armaments (18)	Avionics & Weapons (20)	Warheads & Propulsion (9)
Armor (13)	Crew Protection (11)	Target Acquisition (18)
Power Train (9)	Power Train (10)	Guidance (5)
Vetronics and Fire Control (15)	Enabling Technologies (3)	Enabling Technologies (3)

Total CTEs: 134

Example CTEs (Abrams)

Category	CTEs
Armaments	120mm gun, **penetrators and sabots**
Armor	**Welded hull**, **Special Armor**
Power Train	**Gas turbine engine**, transmission
Vetronics and Fire Control	**Digital architecture**, FLIR common modules

Example CTEs (Apache)

Category	CTEs
Avionics & Weapons	TADS/PNVS, **IHADSS**, and MMW radar
Crew Protection	**Crashworthiness**, composite materials
Power Train	T700 engine, transmission
Enabling Technologies	**Modeling ("T" tail vibration problem)**

Example CTEs (Stinger/Javelin)

Category	CTEs
Target acquisition	**IR/UV detector**, **Imaging IR**
Guidance	Laser ring gyros, tracker
Warhead and Propulsion	**Propellant chemistry**, tandem warhead
Enabling Technologies	**M&S (HWIL)**

Some CTE Sources

Government Labs

- Aberdeen PG
- Forts Belvoir, Eustis, Monmouth
- Arsenals Edgewood, Frankford, Picatinny, Redstone, Watertown, Watervliet
- NASA (Ames, Glenn, Langley)
- Navy (NRL, Indian Head)

Industry

- Chrysler
- GE
- GD
- GM
- Honeywell
- Hughes
- Martin Marietta
- Raytheon
- Rockwell
- TI

Other

- Academia (Delaware, Penn State)
- DARPA
- DOE (LL, Oak Ridge)
- International partners (Germany, UK)

CTE Source Summary

System	Gov't	Industry	Joint	Other*	CTE Total
Abrams	55%	18%	13%	14%	55
Apache	43%	20%	30%	7%	44
Missiles	17%	25%	50%	8%	35

* Those CTEs that were gov't management decisions or that were contributed by allies and academia

Teamwork and Collaboration

- Army in-house experts
- Industry technologists
- Academics
- Other U.S. Government labs
- Overseas allies

Role of Army Laboratories

- Contributed many CTEs
- Collaborated with others on CTEs
- Evaluated performance of prototypes, including fixes for technical problems
- Acted as consultants to contractors and to the Program Manager
- Acted as advisors to the Army to ensure a “smart buyer” capability

Key Factors in Army Labs' Success

- Experts with many years experience in Army specialties
- Ability to sustain efforts over many years
- Relatively low staff turnover
- Effective management
- Long term investments in special facilities – ranges, special laboratories, high performance computing
- Co-location of Army staff at NASA laboratories

Program Manager Role

Responsible for the programs after 6.1-6.3 complete

- Experienced staff – many staff from labs
- Long-standing relations with contractor personnel
- Oversight – systems integration
- Defended the programs when required

Involvement of the User Community

- Definition of needs and requirements
- Continuing discussions during development
- Champions for the programs

Cross-cutting Technologies

- C4ISR – IR technology, GPS, communications networks, microprocessors on the battlefield
- Modeling and simulation
- Materials – armor and armaments, structures, composites, ballistics

The Way Ahead

- Maintain strong in-house Army laboratories – staff, facilities, budget
  - Keep staff at the technical frontiers – use IPA authority, advanced education, details, exchanges, visiting S&Es
  - Alternate personnel systems – expand Lab Demo personnel systems to all DoD labs, add additional delegations of authority – LQUIP proposals
- More collaborations where industry leads technologies
- Continue to strengthen the ties among the in-house laboratories, the PM FCS, and the LSI team

Summary

- CTEs came primarily from the Army laboratories and industry
- CTEs came out of problem-driven research – the "Mining" phase
- Teamwork/collaboration among the participants was essential
- Army laboratory and industry experience was critical
- The Army should:
  - Maintain its laboratories
  - Keep top-flight scientists and engineers on staff
  - Continue to invest in facilities and research equipment
  - Seek permanent delegations of personnel authorities for its laboratories
- The Program Managers played very important roles especially in integration of technologies

Questions?

To Contact Us:

Chaitr@ndu.edu

Lyonsj@ndu.edu